Appendix D-3

Electric Vehicle Battery Charger Safe Design Checklist

**IMPORTANT USER NOTE: This document was created in 2014 by the DoD Electrical Safety Working Group (ESWG) and is based on Codes and Standards in force in 2014. To use this checklist properly, the user must refer to the code in force at the date of use.*

Purpose: Battery charging may present both electrical and fire hazards. This plug-in electric powered vehicle battery charger checklist provides safe design guidance for identifying methods for reducing the risk of injury or fires via incorporation of safe design features.

Requirements: Battery and charger requirements are defined by UL, SAE, and NFPA.

Applicability: Requirement apply to battery chargers used for electrical vehicle charging.

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Charger Make and Model: _____
Date of Inspection: _____
Inspector Name: _____
Contact Email _____
Phone #: _____

Number	Item	Y/N/NA	Comments
1	Does the charging system have electric vehicle signage for identification including visible Caution/Warning Symbols and explanation?		
2	Is the charging system wall mount or located on a pedestal?		
3	Is the charging system installed outside?		
4	Is the charging system exterior adequate for location? Is interior sealed, with no openings that allow insects, dust, or moisture? Is coating material resistant to temperature, UV, and other ambient environmental conditions? If not, describe.		
5	Has the charging electrical system been inspected and approved by government or local electrical inspector to confirm code compliance, i.e., are the electrical system and components compliant to the Code in force ate the time of installation, as well as adequate for the charger level being installed? If not, describe.		

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Number	Item	Y/N/NA	Comments
6	Has the charging system been inspected, tested and approved for usage according to manufacturer installation guidelines? *See Installation and Operations Manual. Is inspection documentation affixed to the charging station?		
7	Does the charging system have a Ground Fault protection with Self-Testing and Auto-Reclosure feature? If a problem occurs that interrupts charging, the unit should automatically clear all error indications after 5 minutes, and attempt to begin charging again. If the problem is immediately sensed a second time, it will wait another 5 minutes and try again. This process will repeat several times, at which point power will be removed and no further attempt will be made.		
8	Does the charging system have a Ground Monitoring Circuit which constantly checks for the presence of a Safety Ground connection?		
9	Has a structurally adequate guard been installed, i.e. safety poles, curbing or other equipment guard, to prevent vehicle impact to the charging system? If so, please describe the type.		
10	Does the charging system have a retractable cord or other device to prevent a tripping hazard from the cord?		

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Number	Item	Y/N/NA	Comments
11	Is the cord fully connected (intact) to the charging system and in good condition? Is cord strain relief provided? If not, please describe.		
12	Does the charging cord properly reach the vehicle for charging with strain? If not, please describe.		
13	Does the charging system have an on/off button or switch and power on lights located on the charger?		
14	Does the charging system have a main power/emergency cut switch other than on the charger? If so, where is it located and how do you get to it? i.e. breaker box, pole or other. Isi it prominently marked in Code complaint signage?		
15	Has adequate lighting been installed around the charging system for nighttime use? If not, describe needs.		
16	Does the charger have a labeled lock out switch to remove any voltage/current when someone is performing maintenance on the charger?		
17	Does the charging system have vandalism safety features on specified charger? Describe.		
18	Can the charger enclosure be opened while the power is still on?		

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Number	Item	Y/N/NA	Comments
19	Are there manufacturer manual warnings regarding charging in wet/rain/snow weather?		
20	Does the charging system have electrical storm safety features? Describe.		
21	Have charger to vehicle connections been verified that they cannot be incorrectly connected or interchanged? Describe.		
22	Have critical functional failure modes been identified and detection methods incorporated? Describe.		
23	NHTSA-SAE-UL Standards, Exemptions or Recommendations: Are there any active exemptions on the charger of interest? If so, please list exemption # and title, date of petition/granted and a brief description of status of exemptions. Also, SAE has listed "Recommended" standards such as J1772. Please advise if the vehicle of interest meet or work is in progress to meet any "recommended" standards of this nature.		
	Is a written operating manual available?		

Additional Codes and Standards Related to Electrical Safe Design of Hybrid Electric Vehicles (EVs and HEVs) Promulgated Through 2015

Note: These requirements were not included in the EV Checklist as it was developed in 2013, but should be incorporated into EV s developed or purchased after date of promulgation.

Code/Standard Number and Edition Year	Code/Standard Title and Summary
NFPA 70, 2014	*National Electrical Code (NEC)®* Article 625, Electric Vehicle Charging System
UL 2594, 2013	*Standard for Electric Vehicle Supply Equipment* Covers conductive EV supply equipment with a primary source voltage of 600 V AC or less, with a frequency of 60 Hz, and intended to provide AC power to an electric vehicle with an on-board charging unit. This Standard covers electric vehicle supply equipment intended for use where ventilation is not required.
SAE J1495, 2013	*Test Procedure for Battery Flame Retardant Venting Systems* Details procedures for testing lead-acid EV batteries to determine the effectiveness of the battery venting system to retard the propagation of an externally ignited flame of hydrogen battery gas into the interior of the battery where an explosive mixture is usually present.
SAE J-1715, 2014	*Hybrid Electric Vehicle (HEV)and Electric Vehicle Terminology* Contains definitions for HEV and EV terminology. It is intended that this document be a resource for those writing other HEV and EV documents, specifications, standards, or recommended practices.

Code/Standard Number and Edition Year	Code/Standard Title and Summary
SAE J-1766, 2014	*Recommended Practice for Electric Fuel Cell and Hybrid Electric Vehicle Crash Integrity Testing* This SAE Recommended Practice is applicable to Electric, Fuel Cell and Hybrid vehicle designs that are comprised of at least one vehicle propulsion voltage bus with a nominal operating voltage greater than 60 and less than 1,500 VDC, or greater than 30 and less than 1,000 VAC. Adequate barriers between occupants and the high voltage systems are necessary to provide protection from potentially harmful electric current and materials within the high voltage system that can cause injury to occupants of the vehicle during and after a crash. This Recommended Practice addresses post-crash electrical safety, retention of electrical propulsion components and electrolyte spillage.
SAE J-2289, 2008	*Electric-Drive Battery Pack System: Functional Guidelines* This SAE Information Report describes common practices for design of battery systems for vehicles that utilize a rechargeable battery to provide or recover all or some traction energy for an electric drive system. It includes product description, physical requirements, electrical requirements, environmental requirements, safety requirements, storage and shipment characteristics, and labeling requirements.
SAE J-2344, 2010	*Guidelines for Electric Vehicle Safety* Identifies and defines the preferred technical guidelines relating to safety for vehicles that contain High Voltage (HV), such as Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Plug-In Hybrid Electric Vehicle (PHEV), fuel Cell Vehicles (FCV) and Plug-In fule Cell Vehicles (PFCV) during normal operation and charging,

Code/Standard Number and Edition Year	Code/Standard Title and Summary
SAE J-2380, 2013	*Vibration Testing of Electric Vehicle Batteries* Describes the vibration durability testing of a single battery consisting of either an electric vehicle battery module or an electric vehicle battery pack.
SAE J-2464, 2009	*Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing* Intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances. It describes a body of tests which may be used as needed for abuse testing of electric or hybrid electric vehicle Rechargeable Energy Storage Systems (RESS) to determine the response of such electrical energy storage and control systems to conditions or events which are beyond their normal operating range.
SAE J-2836-1, 2010	*Use Cases for Communication Between Plug-in Vehicles and the Utility Grid* Establishes use cases for communication between plug-in electric vehicles and the electric power grid, for energy transfer and other applications.
SAE J-2894-2, 2015	*Power Quality Test Procedures for Plug-In Electric Vehicle Chargers* Addresses automatic charger restarts after a sustained power outage, as well as the ability to ride through momentary outage.

Code/Standard Number and Edition Year	Code/Standard Title and Summary
SAE J-2929, 2013	*Electric and Hybrid Vehicle Propulsion Battery System Safety Standard – Lithium-based Rechargeable Cells* Defines a minimum set of acceptable safety criteria for a lithium-based rechargeable battery system to be considered for use in a vehicle propulsion application as an energy storage system connected to a high voltage power train. While the objective is a safe battery system when installed into a vehicle application, this Standard is primarily focused, wherever possible, on conditions which can be evaluated utilizing the battery system alone. .
SAE J-2931-1, 2014	*Digital Communications for Plug-in Electric Vehicles* Establishes the requirements for digital communication between Plug-In Electric Vehicles (PEV), the Electric Vehicle Supply Equipment (EVSE) and the utility or service provider, Energy Services Interface (ESI), Advanced Metering Infrastructure (AMI) and Home Area Network (HAN).
SAE J-2953-1, 2013	*Plug-In Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)* Establishes requirements and specification by which a specific Plug-In Electric Vehicle (PEV) and Electric Vehicle Supply Equipment (EVSE) pair can be considered interoperable.